

## **STEM TEACHER EMPOWERMENT**

**An overview of major programs and/or strategies.** Arkansas mathematics and science teachers are the single most critical effector of change in the initiative to improve educational competence of children who will be the future pool of a knowledge-based workforce. Without qualified, enthusiastic teachers who have the “needed resources” to interest and inspire our children, it is difficult to improve science and mathematics instruction, to increase interest levels of children and young adults, and to promote the continuation of science and mathematics education at the high school and college level. The following proposal is an effort to provide four areas of support to empower Science, Mathematics, Engineering, and Technology (STEM) teachers. The proposal is designed to improve teacher skills and, more importantly, to provide resources for those teachers who desire to challenge their students and to generate student enthusiasm. The empowerment will embody four major themes:

- Professional Development Fellowships and Resource Center Workshops;
- Advancing and Supporting Existing Models Developed or Initiated by Arkansas Teachers;
- Promoting and Supporting New STEM Educational Models; and
- Support for Educational Models in STEM Competitions.

**Expansion of missions of the Arkansas Science & Technology Authority (Authority), the Arkansas Mathematics, Science, and Technology Coalition (Coalition), and the Arkansas NASA Space Grant Consortium (Consortium).** The Authority, the Coalition and the Consortium share the common goal of promoting educational skills that will affect our future workforce. All advocate the need for the strong science, mathematics, engineering and technology educational background that is critical in the knowledge-based economy. It is the belief of these three organizations that programs to empower STEM teachers can initiate the changes needed to improve Arkansas schools. However, it is also our shared belief that any improvements which are sustainable must come from the community and the teachers themselves and that these initiatives grow out of local effort with the desire for improvement. With this in mind, the Authority, the Coalition, and the Consortium have joined forces to develop a program which will empower educators and teachers within the community to strengthen their local STEM programs, each unique to the characteristics of the community and the educators who develop the local projects.

**Description of the goals and objectives of Authority, Coalition, and Consortium and their relationship to the Winthrop Rockefeller Foundation’s mission and program areas of concentration.** The Arkansas Science & Technology Authority is a publicly chartered instrumentality with the statewide mission to bring the benefits of science and advanced technology to the people and state of Arkansas through scientific research, technology transfer and development, and business innovation. This mission is addressed by strategies to promote university funding for research, by supporting innovative technology and entrepreneurial development of knowledge-based companies, and by encouraging improvements in math, science and engineering education. The Authority’s programs are described at. <http://www.asta.ar.gov>.

The Coalition is a nonpolitical network of individuals organized to effect change in Arkansas education by promoting and enhancing mathematics, science, and technology disciplines. The work of the Coalition is attuned to the needs of a worldwide-competitive workplace and directed toward the

Arkansas Science & Technology Authority, the Mathematics, Science and Technology Coalition, and the  
NASA Space Grant Consortium  
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development and implementation of sound education policies and programs that will meet that need. The Coalition is composed of leaders from major Arkansas businesses, leaders of the Arkansas legislature, state agencies, educational experts from Arkansas educational agencies and science centers, and philanthropic foundation directors with interest in education projects. The purpose of the Coalition is:

- to promote educational skills that will affect our future workforce;
- to support high quality math/science/technology education;
- to serve as a think-tank for sharing and brainstorming ideas to improve math/science/technology education;
- to advocate educational models that have proven success in science and math classrooms; and
- to influence educational policy, public understanding, and public engagement in mathematics, science and technology education.

The Coalition also embodies the Network of Regional Mathematics and Science Educational Resource Centers (twelve Math/Science Resource Centers) that are housed on college/university campuses strategically located in diverse geographic regions around the state to serve Arkansas schools. Each center has both math specialists and science specialists to assist teachers in strengthening curriculum and teaching skills and a library of resources and activity materials which may be loaned to teachers.

In 1991 NASA funded Phase II Space Grant states. Arkansas was one of these states and received its "Capability Enhancement Grant" at that time. The University of Arkansas at Little Rock was designated the lead university. There are fourteen campuses involved in the Arkansas Space Grant Consortium including UALR. These campuses are:

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| Arkansas State University, Jonesboro     | Arkansas Tech University, Russellville   |
| Harding University, Searcy               | Henderson State University, Arkadelphia  |
| U of A, Fayetteville                     | Hendrix College, Conway                  |
| U of A at Little Rock                    | Lyon College, Batesville                 |
| U of A for Medical Sciences, Little Rock | Ouachita Baptist University, Arkadelphia |
| U of A at Pine Bluff                     | U of A at Monticello                     |
| University of Central Arkansas, Conway   | University of the Ozarks, Clarksville    |

A representative and one alternate from each member campus is appointed to the Consortium to consider all issues. The current Director is Dr. Keith Hudson. The Consortium meets monthly, as necessary, beginning in September through the annual Symposium in April.

NASA provides funding for the program, and the Consortium has designated \$20,500 for K-12 programs. Most of this money goes directly to K-12 teachers in Mini-Grants of up to \$500, or Outreach Grants of up to \$5,000, with the State of Arkansas and campuses providing matching funds. Awards are made directly to the teacher, and funds must be used for aerospace related materials or activities. Teacher training opportunities in aerospace programs are also supported.

The goals and objectives of the three organizations are compatible with the mission of the Winthrop Rockefeller Foundation to improve the lives of Arkansans by using its resources to build and sustain

strong communities for all Arkansans and by supporting and strengthening organizations that serve them. The focus on Empowering STEM teachers described in this proposal is in-line with the Foundation's interest in promoting the quality of life for Arkansas communities through educational opportunities. Economic opportunity is inherently tied to an individual's educational experiences and a skilled workforce is necessary if Arkansas is to be a vibrant participant in the knowledge-based economy. It is also critical to recognize that unique educational models and projects that "grow out of" Arkansas communities are a source of pride and become self-sustaining. Enhancing the specific resources that STEM teachers may draw upon will therefore not only advance science, mathematics, technology, and engineering skills of our children, but will strengthen our communities.

**Project Description and how it furthers missions of the organizations.** The three organizations are attuned to the need to strengthen Science, Mathematics, Engineering and Technology Education in Arkansas and recognize that any sustainable, embryonic projects that will improve education must be initiated from within the communities rather than imposed upon it. *To that end, we propose a program which will empower educators to develop programs which will enhance STEM education.* This will be a cooperative effort of the Authority, the Coalition and the Consortium leveraging the strengths and resources of each organization. This **four part program** has been developed as a collaboration of the three organizations and will provide teachers with opportunities to work with their communities to improve STEM education in at the local level. The four phases include: opportunities for individual and group oriented professional development to improve teaching skills utilizing hands-on inquiry driven techniques; funding to support projects that engage students in inquiry driven or technology rich activities and that are initiated by teachers who integrate these projects into STEM curriculum in the classroom; and finally by the establishment of competitive programs built around national models that both challenge and engage large numbers of students. The common focus of all these components and the **overall goal of this program is to generate enthusiasm in STEM classrooms around the state using projects that interest and engage students in STEM curriculum and that result in not only increased competence in STEM skill sets but also produce increases in STEM career choices for these students as they advance.**

**Evaluation or measurement of program impact on students, teachers and communities.**

Evaluation is a continuous process that has retrospective (assessing activities and accomplishments), introspective (determining the merit of accomplishments) and prospective (advising for continuous improvement) components. While the Authority and its partners will assist in assessing individual components of the multiple phases of this project (shown in each section), an external evaluator/consultant will provide formative and summative evaluation as follows:

- Provide evidence of the quality and effectiveness of program activities in meeting its stated objectives (outcomes).
- Document the quality and effectiveness of program's basic strategies in creating a trajectory toward its long-term goal (impact).
- Provide evidence of substantive individual and/or system changes in individual teachers and/or participating schools that sustains the impact past the term of the initiative (residue).
- Examine how the structure and operation of the program itself – assets, challenges, leadership, responsiveness, etc. – affects its success in implementing its strategies (organizational efficiency of partners within its context).

In addition, evaluator will play two important process roles within the project:

- Help the project partners relate success and failures to the Foundation in ways that make sense; and
- Act as a " diagnostic resource" for partners in the project, giving feedback and advice from the perspective of someone with the welfare of the project/and children at heart but no vested interest in the program.

**The evaluation plan is built around a set of evaluation questions that address overall goal and objectives outlined in this proposal.**

Evaluation Questions – To what extent:

Are students engaged within the context of their mathematics and science learning?

- Do participating students demonstrate enhanced awareness of and attitudes toward mathematics and science?
- Are changes in student outcomes associated with their teacher's participation in the program professional development and support activities?

Are mathematics and science teacher engaged in inquiry driven instruction within the context of standards-based state framework?

- Do participating teachers demonstrate enhanced awareness of and attitudes toward hands-on inquiry driven instruction?
- Are changes in teacher outcomes associated with their level of participation and support furnished in program professional development or support activities?

Is this program an effective model for building partnerships to infuse enthusiasm into mathematics and science teaching.

- Do professional development and support activities reflect research-based principles of adult learning?
- Are professional development and support activities effective in enhancing participants' knowledge and skills?
- Do participating schools develop local leadership capacity (administrators, counselors and teachers) to drive and sustain desired changes?
- Does the project foster desired interactions and relationships among students, teachers, and/or education centers, higher education faculty, and community professionals?
- Does the project produce high-quality instructional modules linked to standards-based mathematics and science?
- Does the project develop a formal set of materials and plans for use in implementing its model in other settings?
- Do project publications and presentations identify and discuss components and configurations of the model that impact its effectiveness?

Do students in these programs display STEM skills sets that are attributable to the program and is there any evidence of increased choices leading to STEM career pathways?

- Do student in these programs show increases in standardized scores in mathematics and/or science?
- Do students progressing in these programs enroll in STEM college-bound or more demanding curriculum courses in high school?
- Do students participating in these programs show higher choice rate of STEM pathways on career assessment tests?
- Do students coming out of these programs and entering college more often matriculate into STEM majors?

The evaluation plan is detailed and organized to evaluate these questions with specific data elements, data sources, collection methods, schedules, and analytic procedures. The types of data include:

- Teacher, student and administrator questionnaires gather participants' perceptions of the project, as well as attitudes, perceptions, and practices relative to implementing a standards-based inquiry approach to teaching mathematics and science.
- Narrative feedback, including implementation logs and responses to reflective prompts, provides more detailed evidence of increased understanding and incorporation into practice.
- External reviews of modules produced verify quality in the design and construction of the units.
- Site visits to selected sites gather feedback on project strategies and deeper documentation of local activity and context impacting growth and implementation of participants' knowledge and skills.
- Focus groups and individual interviews gather feedback from participants, project personnel, and project partners regarding project activities and impact.
- Observations of a sample of classrooms, professional development sessions, and participant support activities provides richer detail on implementation, to triangulate with broader collection of questionnaire data.
- Student data, including state assessment results, course enrollment data, and locally-generated student products provide information on a range of student outcomes.

Some data collection mechanisms (e.g., teacher questionnaires) are conducted with all participants. Other mechanisms (e.g., site visits, observations) are conducted with a sample of sites and participants. The combination of qualitative and quantitative data, gathered through both project-wide and site-specific means, provides a rich set of triangulated information with which to address the evaluation questions.

## **1. PROFESSIONAL DEVELOPMENT FELLOWSHIPS AND RESOURCE CENTER WORKSHOPS**

**NEED.** The national trends indicating decreases in STEM educational performance of America's children and the somewhat lower than national average test scores of Arkansas children have been attributed to a growing "disinterest" of upper elementary and middle school students in STEM subjects. There is a critical need to revive the interest of children in STEM fields and engage their minds in inquiry-driven activities that will promote increased learning. Such invigoration of classrooms will require an investment in professional development for teachers who directly influence the learning environment in those classrooms.

**The goal of this phase of the program is to improve curriculum and inquiry-driven teaching strategies of upper elementary and middle school classrooms in Arkansas in order to more fully engage students in STEM fields.** To achieve this goal we will target upper elementary and middle school science and math teachers in order to:

- 1). Increase the frequency of use of inquiry-driven activities in mathematics and/or science classroom.**
- 2) Improve the ability of upper elementary/middle school teachers to develop, manage and integrate "hands-on" activities into upper elementary and middle school science and math curriculum.**

**Anticipated outcomes and evaluation techniques (Authority activity):**

- A significant increase in inquiry driven activities during the calendar year of training as compared to average number of activities in previous three years (baseline) as assessed by end of year report of fellowship recipients, as measured in itemized log activities, and by narrative feedback report of question prompts.
- An improvement in attitudes, understanding and management skills for inquiry-driven activities following professional development activities as assessed using pretest and posttest and site visits.

**Project Description: Professional Development Fellowships and Resource Center Workshops:**

**1.1 Fellowships for Science Training day at Resource Centers** (120 Fellowships @ \$200). Often teachers, especially at upper elementary through middle school level, lack either experience, materials, and/or resource activity books to plan stimulating, strong learning activities in the classroom. To provide these teachers with opportunities to gain a more extensive supply of activities to strengthen their curriculum and enhance learning in their classroom, fellowships will be offered for a “training day” at the Math/Science Centers. These fellowships will be distributed to the twelve Math/Science Centers with each center receiving 10 Fellowships to distribute to teachers in their regions to assist with their professional development. The \$200 Fellowships would pay substitute teacher fees for one day, transportation expense and provide funds for purchase of resource materials at the Resource Centers. These teachers will have the opportunity to work individually with a Science or Math Specialist for a day, researching and planning activities to enhance the curriculum in his/her classroom.

**1.2 Supplies for Multi-District Workshops for Inquiry-Based activities at Resource Centers** (\$2,500 x 12 centers). These workshops will be held at the regional Math/Science Centers and will be open to all school districts within the Center’s geographic area. These training events will be topic and grade focused and support STEM curriculum for upper elementary and middle school teachers. Each school district sending teachers will be required to contribute matching funds to help support this effort. The focus of the workshops will be on supplying information and resources for activities that will enhance STEM education. Teachers will have opportunities to develop kits and plan curriculum activities to enrich their classroom syllabus.

The **target audience** is upper elementary and middle school science teachers (# science and #math in public schools) throughout Arkansas. The fellowship program will be a three year program which will focus on teachers in school districts identified with the most need for science enrichment. Professional development workshops will continue during the five years of the program with differing focus topics each year to increase each teacher’s repertoire of activities for the classroom. The professional development workshops and teacher fellowships will occur during the early fall each year for the five years of the program.

**Collaborators.** The Authority and the Coalition with the Network of Regional Math and Science Educational Resource Center will collaborate on this initiative. The Authority staff will handle financial administration, teacher reporting and data analysis of pre- and posttest, and summative reporting of project progress yearly. The Math/Science Centers of the Coalition will furnish the facilities, and training expertise for teacher professional development.

**Community Involvement and Outcomes and Sustainability.** Participating teachers will develop local leadership capacity to drive and sustain the desired changes in the classroom through the professional develop they receive. Classroom changes can directly impact the community since the project will foster desired increases in classroom performance through the interactions and relationships among students, teachers, and/or education centers.

**Intellectual property.** Materials used during fellowships and professional development workshops are from published sources purchased by Math/Science Education Centers or modified from similar resource materials that will be duly referenced. No materials that would be considered intellectual properties will be generated from these activities.

## **2. ADVANCING SCIENCE/TECHNOLOGY MODELS**

**NEED.** There is a need to encourage educational strategies that can impact the science and technology skills of Arkansas students who are the future workforce of our state. As a result, it is imperative to enhance the science, technology, engineering and mathematics (STEM) educational curriculum, to promote the STEM pipeline with efforts to engage students in these areas and promote these career options, and to retain those skilled professionals generated from this effort. The first step in such strategies must be reviving the interest of children in STEM fields and engage their minds in inquiry-driven activities that will promote increased learning.

**The goal of this phase of the program is to improve curriculum and inquiry-driven teaching strategies in STEM classroom in Arkansas by supporting new teacher-initiated projects within programs that have proven success.** To achieve this goal we will provide small grants to science and math teachers or to teacher-teams of interdisciplinary projects that integrate technology rich STEM activities/projects into curriculum in order to:

- 1) Enhance and enrich the STEM curriculum in Arkansas classrooms; and**
- 2) Promote the engagement of Arkansas students in activities that will promote interest in STEM fields and career options.**

### **Anticipated outcomes and evaluation techniques (Authority activity):**

- A significant use of inquiry-driven activities/strategies within the classroom of participating teachers as assessed by end of year report and as measured in itemized log activities and narrative feedback report of question prompts.
- An improvement in attitudes, skills, and knowledge of STEM career opportunities of student in participating programs as assessed using pretest and posttest and site visits.

### **Project Description: Advancing Science/Technology Models**

**2.1 Teacher Training for NASA Student Involvement Programs** (\$2,500 X 12 centers). Workshop training at the Math Science Resource Centers would be held for applying teachers in order to provide an orientation to navigation of NASA materials and become familiar with the rules and guidelines of the NASA program. The NASA Student Involvement Program is a national program of investigations and design challenges for grades K-12 and is open to individuals, teams or whole classes. The programs are set up in a competition format and have Resource Guides that provide instructional materials, tips, and resources for using NASA real time missions for science classroom activity. The materials support national standards, state framework, and local school curricula for science, mathematics, and technology. The program is free and material is downloadable from their website. However, teachers unfamiliar with these programs benefit from the resource center tutorial and hands-on practice with the website.

**2.2. Minigrants for Teachers completing NASA Student Involvement Workshops** (120 minigrants @ \$200 each). Each Science center will have 10 minigrants of \$200 which can be used as startup money for teachers completing the NASA Student Involvement Workshop and needing assistance in this program. District and community support is necessary for the accessory supplies that are used in such competitions. Therefore, districts sending teachers to these workshops would be expected to contribute matching funds to support these projects. School district or community match is essential if a program is to be successful. Teachers from districts that are unable to provide match may request amatch from the NASA Space Grant Consortium Outreach Program.



**2.3 Small Grants for Established NASA Explorer Programs and EAST Models** (15 small grants @ \$1,500 each). Arkansas has some excellent established educational models that need to be encouraged with financial support. To encourage these established programs, small grants would be available through the Authority and Coalition to encourage and enhance new projects within these programs that have relevance to STEM curriculum. The Authority will administer these small project enhancement grants but application and selection will be through the Advisory Panel (composed of the Coalition representatives, Space Grant consortium representatives and educational experts). The intent of these small grants would be to provide seed money to initiate new projects in these model classrooms. School district or community match is essential if a program is to be successful and would be encouraged but not required. Groups from districts that are unable to provide match and that have relevance to the NASA technology goals may request match from the NASA Space Grant Consortium Outreach Program.

The main beneficiaries would be teacher/student groups within such programs as NASA Explorer Schools, EAST Initiative Programs, and other established programs that have shown success in producing innovative, relevant educational reform. There are currently four NASA Explorer Schools in Arkansas, two elementary, one middle school and one high school. Each school has entered into a unique 3-year partnership with NASA in which teachers and administrators working along with NASA personnel and other educational partners promote and support the use of NASA content and programs that address the teams' local needs in mathematics, science, and technology through authentic experiences. Another Arkansas success story is the Environmental and Spatial Technology (EAST) Initiative, of which there are now 141 EAST programs in Arkansas schools. EAST is the result of strong relationships between business, government, and education. This educational model has been recognized nationally as an innovative, relevant, and successful approach to education. The partnerships in the various EAST programs allow students to experience an individualized self-directed, service-oriented, project-based curriculum that is providing value to local schools and communities.

The **target audience** is students and STEM teachers throughout Arkansas. The funding opportunities will be open to teachers wishing to initiate NASA Involvement Programs, to teachers within established NASA explorer schools and to teachers within districts with established EAST programs. The timeline will correlate with the beginning of the 2006 school year and continue on a yearly basis for 5 years. The number of projects will be gradually reduced with focus on disseminating the funds throughout the state with emphasis on rural and economically depressed school districts and communities.

**Collaborators.** The Authority, the Coalition with the Network of Regional Math and Science Educational Resource Center and the NASA Space Grant Consortium will collaborate on this initiative. The Authority staff will handle financial administration, teacher reporting and data analysis of pre- and posttest, and summative reporting of project progress yearly. The Math/Science Centers of the Coalition will furnish the facilities, and training expertise for teacher workshop activities. Outreach personnel who are specialists with NASA website and resources will assist with workshops. The Consortium will also provide matching funds when possible. Members of the Consortium and of

the Coalition along with personnel from the Resource Centers and the Authority will assist with review of project proposals as associated with the advisory committee for project evaluation and selection.

**Community Involvement and Sustainability.** Participating teachers will develop local leadership capacity to drive and sustain the desired changes in the classroom through the small grants that they receive. Classroom changes can directly impact the community since the project will foster desired increases in classroom performance and engagement of students in STEM activities. Such engagement will support the pipeline of students progressing into career in STEM fields.

**Intellectual property.** Materials used from NASA website and professional development workshops are from published NASA sources or modified from similar resource materials that will be duly referenced. No materials that would be considered intellectual properties are generated from these specific activities. However, a disclaimer will be signed by all participating teachers indicating that the Foundation will retain intellectual property rights should any newly created activities generated by the funded projects result.

### **3. PROMOTING AND SUPPORTING NEW STEM EDUCATIONAL PARTNERSHIP MODELS**

**NEED.** There is a need to encourage educational strategies that can impact the science and technology skills of Arkansas students who are the future workforce of our state. As a result, it is imperative to enhance the science, technology, engineering and mathematics (STEM) educational curriculum, to promote the STEM pipeline with efforts to engage students in these areas and promote these career options, and to retain those skilled professionals generated from this effort. The first step in such strategies must be reviving the interest of children in STEM fields and engaging their minds with inquiry-driven activities that will promote increased learning.

**The goal of this phase of the program is to improve curriculum and inquiry-driven teaching strategies in STEM classroom in Arkansas by supporting teacher-initiated newly-developed projects that have great promise for success.** To achieve this goal we will provide small grants to science and math teachers or to teacher-teams of interdisciplinary projects that integrate technology rich STEM classroom curriculum in order to:

- 1) Enhance and enrich the STEM curriculum in Arkansas classrooms**
- 2) Promote the engagement of Arkansas students in activities that will promote interest in STEM fields and career options.**

#### **Anticipated outcomes and evaluation techniques (Authority activity):**

- A significant use of inquiry-driven activities/strategies within the classroom of participating teachers as assessed by end of year report and as measured in itemized log activities and narrative feedback report of question prompts.
- An improvement in attitudes, skill sets, and knowledge of STEM career opportunities of student in participating programs as assessed using pretest and posttest and site visits.

#### **Project Design: Promoting and Supporting New STEM Educational Partnership Models.**

New STEM Educational models which partner with communities, government agencies, universities, or industry to enhance curriculum and develop meaningful relevant projects within their communities will be eligible for small start-up grants. Application of teacher/community initiatives will be submitted to the Advisory Panel of the Coalition, who will evaluate and select qualifying programs. The Authority will administer the funding of the grants. A total of 25 new STEM Educational Partnerships Models (30 grants @ \$1,500 each) will be awarded each year. Matching funds from the partnership will be encouraged but not required. A variety of relevant project types may apply. The scope of projects that could be funded are dependent on the imagination of the teacher and the support of the community partnership that can be generated. The following are a few samples of educational models which have been implemented in other states. The range and kinds of projects that could be initiated will be specific to Arkansas communities but would be comparable in quality with the following examples:

**3.1. Physics at Work** – A partnership of local industry with a physics class to make each lesson in the curriculum a relevant activity which can be modeled in the industry. Such a project would require a team effort of the teacher and industry engineers.

**3.2. Natural State Programs** -Environmental Science Teacher-initiated programs that have an advanced research curriculum unit that is coordinated with Arkansas Audubon or Arkansas Game & Fish Commission.

**3.3. BalloonSat** – Teacher initiated projects that link the use of geospatial IT tools—Geographical Information Systems (GIS), the Global Positioning System (GPS), and image analysis—and community resources. BalloonSat technologies use satellite-like vehicles suspended with a weather balloon equipped with a simple set of integrated systems, sensors for collecting data and tracking devices.

**3.4. Weather/Meteorology** –Teacher initiated projects that incorporate advanced meteorology projects within their curriculum in partnership with state weather bureaus.

**3.5. Engineering projects** - Teachers that partner with community engineers to develop programs for engineering/construction projects, such as those sponsored by American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) and A World In Motion (AWIM).

The **target audience** is junior and senior high students and STEM teachers (3000 science and 3000 math teachers in public schools) throughout Arkansas. The timeline will correlate with the beginning of the 2006 school year and continue on a yearly basis for 5 years. The number of projects will be gradually reduced with continued focus on disseminating the funds throughout the state with emphasis on rural and economically depressed school districts and communities.

**Collaborators.** The Authority, the Coalition with the Network of Regional Math and Science Educational Resource Center and the NASA Space Grant Consortium will collaborate on this initiative. The Authority staff will handle financial administration, teacher reporting and data analysis of pre- and posttest, and summative reporting of project progress yearly. The Math/Science Centers of the Coalition will furnish outreach expertise for teacher needing assistance with some aspects of projects. The Consortium will provide matching funds when possible. Members of the Consortium and the Coalition, along with personnel from the Resource Centers and the Authority, will assist with the review of project proposals as associated with the advisory committee for project evaluation and selection.

**Community Involvement and Outcomes and Sustainability.** Participating teachers will develop local leadership capacity to drive and sustain the desired changes in the classroom through the grants that they receive. Classroom changes can directly impact the community since the project will foster desired increases in classroom performance and engagement of students in STEM activities. Such engagement will support the pipeline of students progressing into career in STEM fields.

**Intellectual property.** A disclaimer will be signed by all participating teachers indicating that the Foundation will retain intellectual property rights to any newly created activities generated by the funded projects.

#### **4. SUPPORT FOR STUDENT STEM COMPETITIONS.**

**NEED.** There is a need to encourage educational strategies that can impact the science and technology skills of Arkansas students who are the future workforce of our state. Since competition and challenges are some of the best activities to stimulate young adults to excel in STEM fields, it is important to support competitive models that will enhance the science, technology, engineering and mathematics (STEM) educational curriculum. Such programs will promote the STEM pipeline by engaging students in these areas and promote these career options.

**The goal of this phase of the program** is to improve curriculum and inquiry-driven teaching strategies in STEM classroom in Arkansas by supporting competition models that have great promise for success. **To achieve this goal we will provide grants to competition/challenge models that engage students in STEM classrooms and promote enriched curriculum in order to:**

- 1) Enhance the STEM curriculum in Arkansas classrooms; and**
- 2) Promote the engagement of Arkansas students in activities that will promote interest in STEM fields and career options.**

#### **Anticipated outcomes and evaluation techniques (Authority activity):**

- A significant use of inquiry-driven activities/strategies within the classroom of participating teachers as assessed by end of year report and as measured in itemized log activities and narrative feedback report of question prompts.
- An improvement in attitudes, skill sets, and knowledge of STEM career opportunities of student in participating programs as assessed using pretest and posttest and site visits.
- Successful deployment of competition models.

#### **Program Description: Support for Student STEM Competitions.**

Model programs that will be supported (with the requirement of matching funds) are established models and/or nationally recognized programs that encourage and recognize excellence but have yet to be widely used in Arkansas.

**4.1. Summer Science Fair Academy.** These are summer day-camp programs for sophomores and juniors to provide training and mentoring for students interested in science fair competition. A model has been developed on the UALR campus and the program and replicas should be initiated at other regional locations. University and industry matching support will be encouraged, but not required. The grant funds needed for startup of these programs will be \$5,000 with a desired match of \$5,000. Programs would be encouraged to seek outside support for sustainability and two programs per year in differing geographical regions would be initiated.

**4.2. EAST Project Fairs and Multi-State Competition.** Moderate support (\$10,000) is needed to sponsor a competition for the student teams on projects in various EAST and/or NASA programs related to STEM initiatives. This funding would host the state competition and send winners of these competitions to national competitions.

**4.3. Engineering Robotics (i.e., BEST).** This moderate grant will support development of a “BEST Hub” which can support up to 24 school districts who will receive supplies and can compete in BEST Robotics Regional competitions. A budget of \$28,000 is required for these programs. This will be done as a partnership match with an industry/college/university engineering center willing to match funds (\$14,000 grant + \$14,000 match). Six new Hubs would be sponsored in differing regions of the state to provide geographic accessibility statewide (Four in years one and two and one each year during three and four.)

**Intellectual property.** A disclaimer will be signed by all participating teachers indicating that the Foundation will retain intellectual property rights to any newly created activities generated by the funded projects.

The **beneficiaries and target of these projects will be** junior and senior high students and STEM teachers throughout Arkansas with the assistance of researchers and faculty of college/university campuses and EAST personnel. The timeline for this work will begin in 2006 and continue through 2011 with new university campuses targeted each year. The number of projects will be gradually reduced with total establishment of ten Science Fair Academy models with wide geographic distribution and six new robotics hubs on college/university campuses with engineering support. EAST competition will be supported in full for three years with a reduction in the fourth and fifth year with increasing business/industry support.

**Collaborators.** The Authority, the Coalition with the Network of Regional Math and Science Educational Resource Center, the NASA Space Grant Consortium, selected university partners and staff of the EAST Initiative will collaborate on this portion of the project. The Authority staff will handle financial administration, reporting and data analysis of questionnaires, and summative reporting of project progress yearly. The Math/Science Centers of the Coalition will support the various team initiatives at individual schools within their service regions. The Consortium will also provide team project funds when possible for individual schools/teams. Members of the Consortium will assist in establishing or identifying personnel on campuses to assist with the Summer Science Fair Academy, and Robotics Centers. The staff of EAST Initiative will assist with arrangements for Arkansas Team Project Competitions.

**Community Involvement and Outcomes and Sustainability.** Participating teachers, school districts, universities and national organizations will help develop local leadership capacity to drive and sustain the desired changes in the classroom through the programs described. Competition will foster desired increases in classroom performance and engagement of students in STEM activities. Such engagement will support the pipeline of students progressing into career in STEM fields.

**Population served by proposal.** Based on the Arkansas Department of Education ([http://www. As-is.org](http://www.As-is.org)), the “2003-04 Census of Enrollment by School District” indicates that the total number of public school students was 452,037 in 308 (now consolidated to 251) school districts. The number of teachers in our public schools involved in STEM education is 6,000 of the 26,000 public school teachers in grades 6-12, approximately 3,000 science and another 3,000 math teachers (information from ADHE, Teacher Quality Initiatives/Academic Affairs).

**Brief history of the Authority.** The Arkansas Science & Technology Authority was created by statute in 1983. The Authority is comprised of a Board of Directors, Advisory Committees and staff. The 14-member Board is appointed by the Governor to staggered four-year terms. The Authority's staff is led by the President, the chief executive officer, who is responsible for the agency's programs, services and support functions. The Authority's activities are divided into three programmatic areas that include research, development and technology. The Board determines the allocation of funds to all projects supported by the Authority. All of the Authority's activities are audited annually to ensure compliance with state and federal guidelines. In its efforts to bring the benefits of science and technology to the people and state of Arkansas, the Authority has set high performance measures and objectives, one of which is to make university scientist, technologist, and engineers more nationally competitive for federal research funds. The Authority follows through by continually supporting entities like Arkansas Biosciences Institute, the Experimental Program to Stimulate Competitive Research (EPSCoR), Arkansas Manufacturing Solutions (AMS), and the Arkansas Department of Economic Development (ADED) with whom it collaborates in the R&D tax credit program. The Authority also supports larger-scale research projects and research infrastructure investments, by working through numerous boards and committees that support strategic research and research infrastructure projects that are relevant to the state's economic growth. Two specific programs that have impacted education and economic development and which have been collaborations with the Winthrop Rockefeller Foundations are the “Innovative Middle School Science Teaching” and the “WRF Entrepreneurial Arkansas.”

**Arkansas Math and Science Coalition and Mathematics and Science Education Center History.** The Arkansas Math, Science and Technology Coalition began in 1993 when Dr. William Durand, mathematics professor at Henderson State University, was named the executive director and received a \$10,000 grant from the National Association of State Math and Science Coalitions (NASSMC) to organize a state coalition. Also in 1993, the National Science Foundation (NSF) awarded Arkansas a ten million dollar grant to begin the Statewide Systemic Initiative to improve mathematics and science education. Dr. Suzanne Mitchell, project director at the Arkansas Department of Higher Education, became the co-director of the coalition and began to connect math and science education needs to business and industry resources. The NSF grant provided the means to create math and science partnerships in five regions of the state and the Arkansas Math and Science Coalition was loosely organized around these business and education regional partnerships. By 2003, the five partnerships

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grew to twelve Centers for Mathematics and Science Education located at institutions of higher education.

In 2004, Sherry Lane was named the new executive director and Henderson State University was awarded a \$20,000 grant from NASSMC to strengthen the coalition, to link science and math leaders to business and industry leaders and policy makers, to provide a communication vehicle to share information about math and science initiatives, and to find a means to sustain three NASA Explorer schools in Arkansas. The twelve Mathematics and Science Education Centers have become financially sustainable entities with university support of staff and general operations, Arkansas Department of Education support of twelve mathematics specialist salaries, and grant support of salaries for the twelve science specialists. Centers help support their work with school districts through consultation fees for services.

**Brief history of the Space Grant Consortium.** The Arkansas Space Grant Consortium was formed in 1991 as a cooperative agreement of seven university campuses funded under a NASA program forming the first Arkansas Space Grant Consortium. In 1994, the Consortium expanded to 13 university campuses throughout the state, and with the addition of a fourteen member, University of Arkansas Monticello, in 1998. The Consortium has a well-established central administration, has been consistently funded, and recently received an addition five year grant (2005-2010) to fund its four part focus. Consortium programs emphasize research infrastructure, undergraduate scholarship and graduate fellowships, K-12 educational outreach (funds for K-12 student space-related programs) and minigrants (\$500 grants available for small classroom projects, trips, materials or teacher training opportunities).

**Combined strengths and weaknesses of the Authority and Coalition.**

| INTERNAL  |  | EXTERNAL   |  |
|---|--|--|--|
| STRENGTHS   |  | OPPORTUNITIES  |  |
| 1. Authority has had experience in administering small grants for teachers and in working with educational reform.  |  | 1. Chance to impact teachers with resources and incentives to improve classroom STEM programs. |  |
| 2. Coalition has extensive and practical knowledge of educational reform needs and understanding of the necessity for community involvement in education. |  | 2. Chance to enhance STEM programs that are successfully impacting students.                   |  |
| 3. Partnership between Authority and Coalition will link grant-administration experience with an educational initiative that has sustainability.          |  | 3. Chance to initiate the development of new STEM educational models.                          |  |
|   |  | 4. Chance to challenge STEM students statewide.  |  |
|   |  |  |  |

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| WEAKNESSES  | THREATS   |
|---|---|
| 1. Public awareness of this program will require effort of all Coalition members with assistance of state agencies (ADE & ADHE) and Math Science Resource Centers to disseminate information. | 1. Community apathy.  |
| 2. Acquisition of Matching Funds may require assistance of Coalition members for help in setting up partnerships.   | 2. Discouragement and diminished enthusiasm of some teachers when faced with overwhelming work load in communities with little support. |